

3 January 2006

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**REPLY TO WRITTEN OPINION**  
**INTERNATIONAL PATENT APPLICATION PCT/FI2005/000134**  
**APPLICANT: ABB OY**  
**DUE DATE: 4 January 2006**

On account of the Written Opinion issued on 30 August 2005 we submit the following:

In the Written Opinion the claims of the present application are considered to lack novelty and an inventive step in the light of the prior art documents D1 (US4108572A), D2 (GB2313197), and D3 (WO03/031918A).

Response to steps 1-4 of the communication:

The applicant respectfully submits an amended set of claims in which the protection scope of the independent claims has been limited to a solution in which:

- a flow measurement result is first obtained with an assumption that a dynamic pressure is a predetermined constant value,
- the obtained flow measurement result is used for obtaining an estimate of the dynamic pressure, and
- said estimate of the dynamic pressure is used for obtaining a more accurate flow measurement result.

The advantage of this kind of solution is the fact that there is no need for pressure sensors that are able to determine the dynamic pressure caused by a pump. The effect of the dynamic pressure can be taken into account in flow rate measurements also in such pumping systems in which only a static pressure prevailing over a pump can be measured. This kind of solution is not disclosed in the cited references D1-D3.



Based on the above-mentioned facts the applicant respectfully sees that the solution recited in the amended independent claims is new and inventive.

The amendments in the independent claims are supported by page 7, line 21 - page 9, line 30 in the specification of the present application and by figure 5 of the present application as follows (the page and line numbers refer to WO 2005/085772 A1):

- measuring a pump power in the pump system (old feature),
- measuring a rotation speed of the pump (old feature),
- measuring a static pressure (page 9, lines 23-25),
- setting an estimate of a dynamic pressure to a pre-estimated constant value (page 8, line 3-4),
- determining an estimate of a total pressure on the basis of the static pressure and the estimate of the dynamic pressure (page 7, equation 4, figure 5),
- determining a first estimate of the liquid flow on the basis of the measured pump power and rotation speed variables (old feature),
- determining a second estimate of the liquid flow on the basis of the estimate of a total pressure and rotation speed variables (old feature),
- determining a flow measurement result by a logical selection or any other predetermined function on said first estimate of the liquid flow and said second estimate of the liquid flow (old feature),
- determining a new estimate of a dynamic pressure on the basis of the flow measurement result (page 9, lines 10-14, figure 5),
- re-determining the estimate of a total pressure on the basis of the static pressure and the new estimate of the dynamic pressure (page 9, lines 15-16, figure 5: loop from block 520 to block 504),
- re-determining the second estimate of the liquid flow on the basis of the estimate of a total pressure and rotation speed variables (page 9, lines 15-16, figure 5: loop from block 520 to block 504), and
- re-determining the flow measurement result by a logical selection or any other predetermined function on said first estimate of the liquid flow and said second estimate of the liquid flow (figure 5: loop from block 520 to block 504).

**Response to step 5 of the communication:**

The specification of the present application uses a term "static pressure" for a pressure difference that is measured/measurable with



pressure sensors connected to an input and an output of a pump, respectively, page 7 lines 25-29 and page 9 lines 23-25.

The specification of the present application uses a term "dynamic pressure" for a pressure rise that is due to a flow speed, page 7, lines 29 – page 8 line 1.

The specification of the present application uses a term "total pressure" for a pressure rise that is a sum of said dynamic pressure and said static pressure and a possible correction term of the static pressure, page 7 lines 21-30. Said correction term of the static pressure takes into account a fact that the pressure sensors may be located at different heights.

Wording dealing with pressures in the amended claims is modified to correspond with the terminology ("static pressure", "dynamic pressure", "total pressure") used in the specification of the present application.

Claims 12, 13, 14, 18 and 19 of the amended set of claims have been modified to define apparatus in terms of its technical features.

Response to step 5.3b: The applicant respectfully submits an amended specification in which the subject matter of the dependent claims 3 and 13 has been added in page 8, lines 1-18 of the amended specification. Terms "first flow value range" and "first flow value range" have been replaced by terms "range using the power-based flow definition" and "range using the pressure-based flow definition", respectively, in order to make the added text portion to be commensurate with the terminology used in a paragraph that locates before the added text portion.

Response to step 5.3a: The applicant respectfully recites that a purpose of the phrase "the flow change sensitivity to a specific relative power change" in the dependent claims 3 and 13 is to represent the following sensitivity quantity:

$$\Delta \text{Flow} / (\Delta \text{Power}/\text{Power}) = \text{Power} * d(\text{Flow})/d(\text{Power}), \quad (\Delta = \text{change})$$

wherein  $\Delta \text{Flow}$  is the flow change caused by the relative power change  $\Delta \text{Power}/\text{Power}$ ,

Correspondingly, the phase "the sensitivity to the same relative change in the liquid pressure" represents the following sensitivity quantity:

$$\Delta \text{Flow} / (\Delta \text{Pressure}/\text{Pressure}) = \text{Pressure} * d(\text{Flow})/d(\text{Pressure}),$$

wherein  $\Delta \text{Flow}$  is the flow change caused by the relative pressure change  $\Delta \text{Pressure}/\text{Pressure}$ .



These sensitivities are the entities that are compared with each other when defining the two flow value ranges. The amended dependent claims 3 and 13 have been modified to correspond better with the above-mentioned generally known mathematical definitions of said sensitivities.

The amended specification has been modified to correspond with the amended independent claims in page 3, line 36 – page 5, line 18.

No new subject matter has been added on the amended specification and the amended set of claims.

The applicant respectfully asks that the amended set of claims and the amended specification are used for further considerations of the present application.

The amended specification and the amended set of claims are enclosed as an attached document of this response letter.

**BERGGREN OY AB**

Matti Brax  
Patent Attorney

Encl.

A document including the amended specification and the amended set of claims (18 pages).